1. What Foreign Research Reactor Spent Fuel Is

1.1 What is spent nuclear fuel?

Nuclear reactors use fuels that contain enriched uranium. After the fuel is placed inside the reactor, fission—the splitting of uranium atoms—occurs. After some time, the nuclear fuel is no longer able to operate efficiently. This used fuel, which still contains much of the enriched uranium, is called spent nuclear fuel. Spent nuclear fuel is thermally hot and highly radioactive.

1.2 What is enriched uranium?

Uranium is generally unsuitable in its natural state for making nuclear fuel or nuclear weapons because it contains only a small amount—about 0.7 percent by weight—of uranium-235. Uranium-235 is the form, or isotope, of uranium capable of fission.

To make uranium ore usable for fuel or weapons, it is processed to increase its content of uranium-235. This process is called enrichment. Uranium enriched to contain less than 20 percent of uranium-235 is called low-enriched uranium; uranium enriched to contain 20 percent or more of uranium-235 is called highly enriched uranium.

1.3 What is foreign research reactor spent fuel?

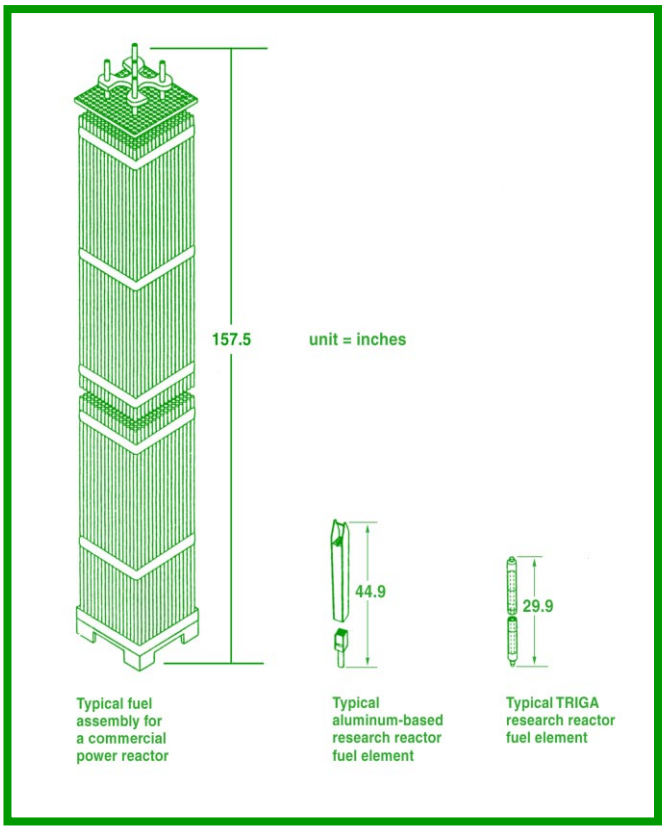
Foreign research reactor spent fuel is spent nuclear fuel from research reactors in countries other than the United States. Research reactors use nuclear fuel for a variety of purposes, including nuclear medicine; environmental, agricultural, and climate studies; basic scientific research; and development of new industrial materials and technologies. Research reactors are typically much smaller than nuclear power reactors that generate electricity.

As used in this document, the term "foreign research reactor spent fuel" refers only to spent nuclear fuel from foreign research reactors that contains U.S.-supplied enriched uranium. This distinction is important because the United States is committed to taking back this spent fuel for final disposition. The U.S. Department of Energy (DOE) is responsible for the safe management and disposal of foreign research reactor spent fuel upon its return to the United States.

1.4 What are the physical characteristics of foreign research reactor spent fuel?

Foreign research reactor fuel elements come in a variety of forms. They all consist of a fuel matrix (which contains the uranium), a cladding material that encloses the fuel matrix, and structural hardware that holds the pieces of the fuel element together.

The fuel matrix of a research reactor element typically consists of enriched uranium in an alloy of aluminum or zirconium hydride. The enriched uranium (which is solid and does not dissolve in water) may contain up to 93 percent uranium-235 by weight. The fuel matrix may take the form of flat or curved plates, tubes made of three curved plates, or pellets combined into rods.



The cladding of a research reactor element is usually made of aluminum or stainless steel. The purpose of the cladding is to confine and protect the fuel matrix.

The structural parts of a research reactor element are usually aluminum. Their purpose is to hold fuel plates or tubes in the proper configuration and to direct the flow of coolant over the fuel.

Research reactor fuel elements weigh from about 2.2 pounds to more than 220 pounds, and they range in length from about 2.5 feet to 9 feet.

1.5 How does spent fuel from foreign research reactors differ from spent fuel from commercial nuclear power plants?

Spent nuclear fuel from commercial power reactors differs significantly in several respects from spent nuclear fuel from research reactors:

- Commercial nuclear power reactors use only low-enriched uranium, typically enriched to about 4 to 5 percent. Research reactors use uranium enriched to just below 20 percent to over 90 percent.

- Fuel elements from commercial power reactors are much larger (about 14 feet long and 8 inches square) and much heavier (about 1,200 pounds) than research reactor elements.

- Research reactors usually operate at much lower power levels and for much shorter periods than commercial power reactors. As a result, fuel elements in research reactors last longer and need to be changed less often than fuel elements in commercial power reactors.

The volume of spent fuel from foreign research reactors to be stored in the United States is also much smaller than the volume of stored spent fuel from commercial power reactors. Over a 13-year period ending in May 2009, DOE expects to receive about 19.2 metric tons of spent fuel from foreign research reactors, while the volume of commercial spent nuclear fuel stored in the United States today exceeds 34,000 metric tons. (One metric ton equals 2,204.6 pounds.)

A Guide to

Foreign Research Reactor Spent Fuel